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Appropriation, Human Capital, and Mandatory Schooling

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Working Papers

APPROPRIATION, HUMAN CAPITAL, AND MANDATORY SCHOOLING

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APPROPRIATION, HUMAN CAPITAL, AND MANDATORY SCHOOLING

Abstract

Reduced inequality in human capital may reduce appropriation from the rich. They may therefore favor policies such as income transfers and mandatory schooling which equalize human capital. Comparing several such policies, we find that mandatory schooling leads to higher incomes for both the rich and the poor, and increases the welfare of all. Moreover, it is the optimal policy for the rich, even when they fully pay for the education.

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1 Introduction

Education is often subject to government intervention, with public provision, subsidization, and compulsory attendance. Indeed, education is one of the few goods whose consumption government mandates. Moreover, though the poor may be the main direct beneficiaries of public education, it is often the rich elite who promoted mass education and, in particular, supported compulsory education. This suggests that the rich may benefit from public education for the poor, sometimes more than the poor do.

This paper analyzes one externality from education which may induce the rich to encourage education for the poor—education may reduce appropriative activity. As the literature recognizes (see, for example, Grossman, 1994, 1995, Bertocchi and Spagat, 2000), the threat of appropriation may induce the rich to favor redistribution to the poor. Here we compare three policies that may reduce appropriation: income transfers, compulsory schooling, and education subsidies. We find that if the endowments differ sufficiently, the rich will oppose income transfers and oppose subsidies to education. But they may favor compulsory schooling (even when they fully finance it), with the aim of reducing appropriation. Even when the rich can reduce appropriation by spending on the protection of private property (through the police force, security alarms, etc.), they may still support compulsory schooling.

This preference for compulsory schooling may explain historical episodes where this policy preceded other redistributive policies. In Prussia, for example, schooling was made compulsory in the early nineteenth century, with full funding by the landed nobility, and by the mid-century it was effectively imposed.[1] In contrast, the Bismarckian social legislation was introduced much later, towards the end of the century.

2 Literature

Our analysis of education resembles the analysis of land reform (as in Grossman, 1994), and of wage equalization (as in Grossman, 1995). Bertocchi and Spagat, 2000, study how income equalizing transfers can co-opt some of the poor thus avoiding insurgency. Grossman and Kim, 1999, examine the same effect of education we do, showing how equalizing educational spending across individuals may reduce future redistribution.

The empirical connection between education and crime is studied by several authors. Ehrlich, 1975, finds that education (and a more equal distribution of income) reduce property crimes. Donohue and Siegelman, 1998, find that preschool enrichment programs (coupled with family intervention) reduce crime. Grogger, 1998, notes that crime rates typically increase with age until the late teens, and then decline. The relation is consistent with the hypothesis that the opportunity cost of crime is wages, that wages rise steeply with age in the early part of a career, and that education increases wages. Witte, 1997, in surveying

[1] See Good and Teller, 1969, for a history of public education in Germany.

the empirical work, concludes that neither years of schooling completed nor receipt of a high school degree significantly affects a person's level of criminal activity. But a person is less likely to commit a crime if he is at work or at school rather than free from the supervision involved in those activities.

The literature on endogenous growth focuses on how increased aggregate human capital enhances productivity; Eckstein and Zilcha, 1994, study the consequent benefits of mandatory schooling. Our analysis complements and reinforces the analysis of Bourguignon and Verdier, 2000. They show how the current majority may want to increase the number of educated voters in the future, despite their eventual loss of political power. We find the same effect for non-political reasons. Moreover, whereas Bourguignon and Verdier's result is consistent with the rich favoring subsides to high-school education over subsidies to elementary education, our model makes sharper predictions, consistent with the historical experience that elementary education was compelled or subsidized before high school education was. And unlike political models, our model does not predict that the poor would object to education by the rich.

A frequently used alternative explanation for mandatory policies relies on moral hazard and time inconsistency. Specific applications of these ideas to mandatory education as a second-best policy are provided in Boadway et al., 1996, and in Konrad, 2001. Another explanation has to do with socializing aspects of education as studied by Lott, 1990, and Usher, 1997. The externality of schooling can be interpreted as inculcating common norms, and compulsory schooling, according to this literature, increases social cohesion.

Thus, the effect of education on crime can be modeled in at least three ways. First, education may change the preferences of people. Second, time at school or at work may substitute for time at crime. Compulsory education or subsidies to education can then reduce crime, and perhaps do that more cheaply than subsidies to work. Third, education may increase a person's wage, thereby inducing him after the completion of education to engage in production rather than in crime. For simplicity, we shall model the last effect, though a model which focuses on the allocation of time between education and crime would lead to similar results. The main difference between our paper and earlier contributions in this regard is that we compare several alternative policies to reduce inequality, specifically showing when compulsory schooling dominates.

3 Assumptions

Consider an economy populated by two households, indexed by i. The poor household (p) has a small initial endowment; the rich household (r) has a large endowment. Each household consists of a father and a son. Fathers live in period 1; sons live in period 2. In period 1 each father allocates his endowment (or exogenously set income) between private consumption and spending on education. In period 2 each son either works or steals. Productive work increases total output in the economy; theft redistributes income.

The gross income of individual i in generation $t, t = 1, 2$ is y_{it}; his con-

sumption is c_{it}. Let a father's private spending on his son's education (we say private spending, leaving open the possibility that taxes are imposed to finance education) be e_i. Then father i's budget constraint is

$$y_{i1} = c_{i1} + e_i. \tag{1}$$

Son i uses a fraction x_i of his time in theft, and a fraction $1-x_i$ in production. Lending and borrowing are infeasible. Education increases productivity at work, but not at appropriation.[2]

Interpreting e_i as the productivity parameter and assuming for simplicity the "Ak" technology, earned income is

$$y_{i2} = e_i(1 - x_i). \tag{2}$$

Theft expropriates income from the other person according to the production function bx_i, where $0 < b < 1$.[3] The share of income appropriated by individual i is therefore $bx_i y_{j2}$ for $i \neq j$. Thus, son i's total income, and hence his consumption, is

$$c_{i2} = y_{i2}(1 - bx_j) + bx_i y_{j2}. \tag{3}$$

Each parent's utility increases with his own consumption and with the anticipated consumption of his child:

$$U(c_{i1}, c_{i2}). \tag{4}$$

The utility function satisfies the standard assumptions, with both its arguments normal goods.

When schooling is voluntary, parents simultaneously allocate their budgets, anticipating the time allocation decisions of the sons. Alternatively, the rich parent may first set educational policy. For instance, under compulsory schooling the rich parent can set the level of mandatory schooling level, which he finances. Or he can transfer income to the poor parent to induce that parent to spend more on education. Or else the rich parent can subsidize spending on education by the poor parent. The rich parent chooses which policy to apply and at what level. Thereafter the two parents make their decisions as before.

4 Voluntary schooling

Consider first education with no governmental interference. The analysis proceeds backwards, starting with a son's decision whether to steal. Each son maximizes $c_{i2} = y_{i2}(1 - bx_j) + bx_i y_{j2}$ subject to $y_{i2} = e_i(1 - x_i)$. Linearity of

[2] Alternatively, we could assume that education also increases productivity at appropriation, but at a smaller rate.

[3] For simplicity we disregard here the possibility of protecting oneself against the threat of appropriation; see, however, Grossman and Kim, 1999, for the analysis of this possibility.

consumption in period 2 in time spent on theft implies that the optimum has corner solutions. In particular, the first-order condition is

$$-e_i(1 - bx_j) + be_j(1 - x_j) < 0 \text{ and } x_i = 0 \tag{5}$$

or

$$-e_i(1 - bx_j) + be_j(1 - x_j) > 0 \text{ and } x_i = 1. \tag{6}$$

Similar equations hold for j.

Analysis of equations (5) and (6) shows that $x_i = x_j = 1$ cannot simultaneously hold; instead, at least one person works. This leaves the following possibilities:

$$x_i = x_j = 0 \text{ if } -e_i + be_j < 0 \text{ and} - e_j + be_i < 0, \tag{7}$$

$$x_i = 0, x_j = 1 \text{ if } -e_i + be_j > 0 \text{ and} - e_j + be_i > 0, \tag{8}$$

$$x_i = 1, x_j = 0 \text{ if } -e_i + be_j > 0 \text{ and} - e_j + be_i > 0, \tag{9}$$

Consider the first period, where each parent chooses educational spending to maximize his utility, $U(c_{i1}, c_{i2})$. Clearly, a parent who expects his son to steal (or expects $x_i = 1$) spends nothing on education, so that $e_i = 0$. Consider an equilibrium where exactly one son engages in appropriation. The utility of the parent of an uneducated son is

$$U(y_i, be_j^*). \tag{10}$$

The utility of parent j whose son is educated is

$$U(y_j - e_j^*, (1 - b)e_j^*), \tag{11}$$

where e_j^* maximizes $U(y_j - e_j, (1 - b)e_j)$. But incentive compatibility ensures that the equilibrium is unique, with only the rich parent spending on education, expecting his son to work. The poor parent spends nothing on education, expecting that his son will engage in appropriation. Specifically, we have

$$e_p^* = 0, x_p^* = 1, \text{ and } e_r^* > 0, x_r^* = 0. \tag{12}$$

The resulting utilities are

$$U(y_p, be_r^*) \tag{13}$$

and

$$U(y_r - e_r^*, (1 - b)e_r^*). \tag{14}$$

Aggregate income in period 2 is then e_r^*.

Note that the equilibrium is inefficient: a transfer from the rich to the poor parent conditional on an appropriation ban would make bothe parents better off.

Another possible equilibrium has both parents spend on education and both sons work:

$$e_i^{**} > 0, x_i^{**} = 0, \text{ for } \ i = p, r \tag{15}$$

where

$$e_i^{**} = \text{argmax } \ U(y_i - e_i, e_i). \tag{16}$$

To recall the notation, think of * as showing one child going to school, and of ** as showing two children going to school. An even stronger solution, which we will indicate by ***, has compulsory schooling.

Utility with both sons educated is

$$U(y_i - e_i^{**}, e_i^{**}). \tag{17}$$

Total income in period 2 is then $e_p^{**} + e_r^{**}$, and the allocation is efficient.

We shall assume that a smaller marginal product of education cannot result in more spending on education by the rich parent. This implies that, when no appropriation is expected, spending on education, e_r^{**}, is at least as high as spending on education,, e_r^*, when a fraction $(1-b)$ of the child's income will be appropriated:[4]

$$e_r^{**} \geq e_r^*. \tag{18}$$

This assumption guarantees that the equilibrium with both children attending school results in a higher next-period income than the previous equilibrium, where the poor parent spends nothing on education.

The solution with the poor son getting no education constitutes an equilibrium if it results in a higher utility than when the poor father educates his son who then works:

$$U(y_p, be_r^*) > U(y_p - e_p^{**}, e_p^{**}). \tag{19}$$

The inequality holds for a sufficiently large difference in income: the poor parent then prefers not educating his son, anticipating that his son will appropriate from the rich son. The inequalities $U(y_p, be_r^*) > U(y_p - e_p^{**}, e_p^{**})$ and $e_r^{**} \geq e_r^*$ ensure that the unique equilibrium has the poor son engaging in appropriation: if $e_r^{**} \geq e_r^*$ and $U(y_p, be_r^*) > U(y_p - e_p^{**}, e_p^{**})$, then $U(y_p, be_r^{**}) > U(y_p - e_p^{**}, e_p^{**})$, ruling out the equilibrium where the poor son works.

To summarize,

[4] In turn, this assumption is satisfied when the elasticity of the marginal utility from son's consumption is small.

Proposition 1 *If the endowments of the rich and of the poor parents little differ, then both parents educate their sons, and their sons work. If the endowments differ sufficiently, so that* $U(y_p, be_r^*) > U(y_p - e_p^{**}, e_p^{**})$*, then a unique equilibrium exists with the rich parent educating his son and expecting his son to work, and with the son of the poor parent engaging solely in appropriation; the resulting incomes in the following period are then relatively small and the equilibrium is inefficient.*

The Proposition implies that high inequality of endowments leads to appropriation, which reduces growth and induces welfare losses. That solution is consistent with the observation of Adam Smith that "the a- uence of the rich excites the indignation of the poor, who are often both driven by want and prompted by envy, to invade his possessions" (Smith, 1937, p. 670; quoted from Ehrlich, 1975). For our later analysis, we shall assume henceforth that (19) is satisfied, so that when schooling is voluntary, the equilibrium has appropriation and low educational spending.

5 Educational policies

This section studies different educational policies which aim to reduce appropriation. We examine them from the point of view of the rich parent, thus implicitly assuming that he controls policy.

5.1 Compulsory schooling

Suppose that the rich parent can require the poor son to attend school, which the rich finances.[5] Let the level of compulsory schooling be C; that is also spending by the rich parent on educating the poor son. The rich parent determines C. The poor father can supplement compulsory schooling with his own spending on education. After that, in period 2, the sons decide whether to work.

Let the the poor parent buy additional schooling of z_p. Clearly, the rich will finance compulsory schooling only if it eliminates appropriation. This, in turn, happens if the utility of the poor parent who educates his son exceeds the parent's utility if his son is uneducated and so will appropriate from the son of the rich. Since the optimal value of C for the rich parent is the smallest value that satisfies this, we obtain the characterization:

$$z_p = \text{argmax} \;\; U(y_p - z_p, C + z_p) \tag{20}$$

and

$$e_r^{***} = \text{argmax} \;\; U(y_r - C - e_r, e_r). \tag{21}$$

[5] When schooling is compulsory but not subsidized, the rich parent clearly gains; but this case is uninteresting.

Denote by $H(y, q)$ the demand by a parent for his son's education when the parent's endowment is y and the price of education is q. We then have

$$z_p = \max\{0, H(y_p + C, 1) - C\} \tag{22}$$

and

$$e_r^{***} = H(y_r - C, 1). \tag{23}$$

Note that when the endowment of the poor parent is sufficiently smaller than the rich parent's, the equilibrium with compulsory schooling has the poor parent choose education just equal to the compulsory level, so that $z_p = 0$ and $C = be_r^{***}$. The resulting utilities are

$$U(y_p, be_r^{***}) \tag{24}$$

and

$$U(y_r - C - e_r^{***}, e_r^{***}). \tag{25}$$

We now compare the utility of rich parents under voluntary schooling to utility under compulsory schooling. The utility under voluntary schooling is

$$U(y_r - {e_r}^*, (1-b)e_r^*) = U(y_r - c_{r2}^*/(1-b), c_{r2}^*), \tag{26}$$

Since spending by the rich on compulsory schooling is $C = be_r^{***}$, a rich parent's utility under compulsory schooling is

$$U(y_r - (1+b)e_r^{***}, e_r^{***}) = U(y_r - (1+b)c_{r2}^{***}, c_{r2}^{***}). \tag{27}$$

Since $b < 1$, it follows that $1/(1-b) > 1+b$, implying that the price of a child's consumption is higher under voluntary schooling than when schooling is compulsory. But then it follows that $U(y_r - c_{r2}^*/(1-b), c_{r2}^*) < U(y_r - (1+b)c_{r2}^{***}, c_{r2}^{***})$, so that compulsory schooling yields higher utility for the rich father. And for the same reason the rich father's consumption is also greater under compulsory schooling. If, in contrast to the assumption made above, the endowments differ little, so that the poor parent chooses to supplement compulsory schooling, then that level of schooling is even smaller than be_r^{***}, implying *a fortiori* that compulsory schooling benefits the rich parent. And recalling that the poor parent is not made worse off, we conclude that compulsory schooling increases welfare. To summarize,

Proposition 2 *Compulsory schooling for the poor increases the rich parent's utility, even if the rich parent pays for the schooling. Since the poor parent is as well off with compulsory schooling as without it, compulsory schooling is efficient.*

This result echoes a related one in Gradstein, 2000, who focuses on voting, whereas we consider violent appropriation. The intuition behind the proposition lies with commitment effects: compulsory schooling ensures that future appropriation is reduced, thereby increasing the income of a rich son.[6]

[6] A Cobb-Douglas example used to explicitly compare the effects of voluntary and compulsory schooling is available upon request.

5.2 Income transfers

Suppose next that the rich parent, instead of compelling schooling, transfers income to the poor parent. That is, first, the rich sets the transfer, T. Then parents choose education for their sons. Lastly, the sons allocate their time between work and appropriation. Clearly, any such transfer will only be made if it induces educational choices that reduce appropriation by the sons. Also, the rich parent will choose the smallest transfer that meets this criterion. Hence, any positive transfer, T, satisfies the conditions

$$U(y_p + T - e_p, e_p) = U(y_p + T, be_r) \tag{28}$$

$$e_p = H(y_p + T, 1), \tag{29}$$

and

$$e_r = H(y_r - T, 1). \tag{30}$$

The rich parent gains from making a transfer only if

$$U(y_r - T - e_r, e_r) > U(y_r - e_r^*, (1-b)e_r^*). \tag{31}$$

Differentiating $U(y_p + T - e_p, e_p) = U(y_p + T, be_r)$ shows that $dT/dy_p < 0$, so that the higher the endowment of the poor parent, the smaller is the transfer. This implies that when the endowment of the poor parent is sufficiently high, $U(y_r - T - e_r, e_r) < U(y_r - e_r^*, (1-b)e^*)$, and the rich parent makes no transfer.

Proposition 3 *When the poor parent's endowment is sufficiently low, the transfer required to make the poor son work is so high that no transfer is made. The poor parent will therefore not educate his son, and his son will engage in appropriation.*

Suppose now that the condition in Proposition 3 fails to hold, so that the rich parent makes a transfer. Which of the two policies, compulsory schooling or income transfer, does the rich parent prefer? The answer is not obvious, since compulsory education is a more direct tool than a transfer, but requires the rich to pay for all the mandated education; a transfer needs only induce the poor parent to spend on education.

Suppose first that with the optimal compulsory schooling the poor parent chooses to supplement education. Then (see the Appendix for proof) the rich parent prefers compulsory schooling. The reason is as follows. Suppose that $T = C$. Then the poor son's consumption is the same under both policies. But since a poor parent would not spend all of a transfer on education, the utility of a poor parent would be higher under a transfer of C than under compulsory schooling of the same amount. Since the rich parent chooses a policy which guarantees that the poor is just indifferent between appropriating and working, T must exceed C.

Assume now that the poor parent prefers not to supplement education, so that $z_p = 0$ and therefore (from the condition $U(y_p+T-e_p, e_p) = U(y_p+T, be_r)$) that $C = be_r^{***}$. This happens when

$$-U_1(y_p, be_r^{***}) + U_2(y_p, be_r^{***}) = 0. \tag{32}$$

This equation holds when the endowments of the rich and of the poor greatly differ. As proven in the Appendix, compulsory schooling then imposes a smaller burden on the rich parent, who therefore prefers it to the income transfer.

To summarize,

Proposition 4 *The rich parent prefers compulsory schooling over income transfers to the poor.*

The intuition here is that compulsory schooling is better targeted than transfers to reduce future income inequality, and hence to reduce appropriation.

5.3 A stick and a carrot

Suppose now that the rich, in addition to mandatory schooling, can also protect their property by spending on protection, for example on the police.[7] Formally, let d represent the amount of such spending by the rich parent. The fraction of protected property is assumed to increase monotonically with this spending; in other words, denoting by $B(d)$ the *un*protected fraction, $B' < 0$. In addition, $B(0) = b$, so that b is interpreted as the unprotected fraction of property in the absence of any spending on protection. The issue we address here is whether the rich parent would still want to mandate schooling.

To study this issue, suppose that the rich parent considers packages of policies to limit theft, where each package consists of different levels of mandatory schooling and of property protection. The optimal package maximizes the rich parent's utility while making the poor son indifferent between engaging in appropriation and working. Again, policy choices precede education and appropriation decisions. Thus, the rich parent solves the problem:

$$\begin{aligned} &Max_{C,d} U(y_r - C - d - e_r, e_r) \\ \text{s.t.} \quad &U(y_p - z_p, C + z_p) - U(y_p, B(d)e_r) = 0 \end{aligned} \tag{33}$$

anticipating the optimal education decisions.

To show that mandatory schooling can be optimal, consider Cobb-Douglas preferences, $U(c_{i1}, c_{i2}) = \log(c_{i1}) + \log(c_{i2})$. We also confine attention to the case where the poor parent supplements mandatory schooling. Calculation shows that the optimal amount of education spending by the rich parent, given the policy (C, d), is $e_r = (y_r - C - d)/2$. The utility of the poor parent when appropriation occurs is thus $\log(y_p) + \log(B(d)(y_r - C - d)/2)$. If, in contrast,

[7] Incentive compatibility conditions ensure that only the poor will never engage in protecting their property.

no appropriation occurs, optimal supplementary schooling by the poor is $z_p = (y_p - C)/2$, resulting in utility $2\log((y_p + C)/2)$. Then (33) becomes

$$Max_{C,d}[2\log((y_r - C - d)/2)] \tag{34}$$
$$\text{s.t.} \quad 2\log((y_p + C)/2) - [\log(y_p) + \log(B(d)y_r - C - d)/2)] = 0$$

The corresponding dual problem is

$$Min_{C,d}\{2\log((y_p + C)/2) - [\log(y_p) + \log(B(d)(y_r - C - d)/2)]\} \tag{35}$$
$$\text{s.t.} \quad C + d = k,$$

where k is a constant. Differentiating the objective function with respect to C while respecting the constraint shows that if $2/y_p + B'(d)/B(d) > 0$ then C is positive. This implies then that the rich impose mandatory schooling. Thus, we obtain

Proposition 5 *Spending only on protecting property may be suboptimal for the rich. Some level of mandatory schooling—together with property protection—could be optimal.*

6 Conclusion

Inequality may induce some people to engage in appropriation instead of production. Public policies which reduce inequality may therefore lead sons to reallocate effort from appropriation to production. Our comparison of several such policies indicates that compulsory schooling leads to higher income for both the rich and the poor; when inequality is high, income transfers and educational subsidies do not. Furthermore, compulsory schooling, even when financed by the rich, is the policy the rich would prefer.

These advantages of compulsory schooling policy may seem surprising, as it constrains individual choice more than do other policies. In our model, however, this constraint is a benefit, since it reduces appropriation, and it does so at a lower cost for the rich parent. This may explain why, historically, the rich elite sometimes favored compulsory schooling.

7 Appendix

7.1 Comparing compulsory schooling to income transfers

Since both compulsory schooling and income transfers can eliminate appropriation, the rich parent's utility is either $U(y_r - C - e_r, e_r)$ under compulsory schooling, or $U(y_r - T - e_r, e_r)$ under the income transfer. Hence, the comparison from his viewpoint hinges on whether $C > T$.

Suppose first that the poor supplement compulsory schooling. Using our usual notation, the poor parent's indifference condition, which determines C, is

$$U(y_p + C - H(y_p + C, 1), H(y_p + C, 1)) = U(y_p, bH(y_r - C, 1)). \tag{36}$$

Similarly, the indifference condition which determines T is

$$U(y_p + T - H(y_p + T, 1), H(y_p + T, 1)) = U(y_p + T, bH(y_r - T, 1)). \tag{37}$$

Differentiation shows that the left-hand side in (36) increases with C and that (37) increases with T. When $T = C$, the right hand side in (37) exceeds that in (36), implying that T must exceed C.

When the poor parent does not supplement compulsory schooling,

$$C = H(y_p + C, 1), \tag{38}$$

so that $z_p = 0$, and

$$C = be_r^{***} = bH(y_r - C, 1). \tag{39}$$

This implies that

$$H(y_p + C, 1) = bH(y_r - C, 1). \tag{40}$$

In contrast, (37) implies that

$$H(y_p + T, 1) > bH(y_r - T, 1). \tag{41}$$

Together, the above two equations imply that $T > C$, thus proving the claim.

7.2 Education subsidies

Consider a subsidy by the rich for educational spending by the poor. Let the subsidy per unit of spending be s; the total subsidy is se_p. The sequence of events is as follows. First, the rich parent determines s; then each parent chooses how much to spend on his son's education; lastly, the sons allocate their time between work and appropriation. Once again, the comparison is not obvious. Compulsory education directly sets education by the poor. But it is costly to the rich, who must fully pay for the compulsory schooling. A subsidy is an indirect way of inducing education, but need cover only part of the costs of education.

Clearly, the rich favor a subsidy only if it induces sufficiently high education for the poor son so that he will engage in production. Under any subsidy, the poor parent will educate his son only if the parent's utility exceeds utility with no such spending and with the son therefore engaging in appropriation.

Let spending on education chosen by the parents be e_p and e_r, which satisfy $e_p = H(y_p, 1-s)$, $e_r = H(y_r - se_p, 1)$, and $e_p > be_r$. These conditions determine the minimal subsidy which ensures that the poor son prefers to work.

A poor parent who spends on education has utility

$$U(y_p - (1 - s)e_p, e_p). \tag{42}$$

The rich parent's utility is

$$U(y_r - se_p - e_r, e_r). \tag{43}$$

The subsidy needed to ensure that the poor parent spends on education, so that these utilitity levels are realized, is

$$U(y_p - (1-s)e_p, e_p) = U(y_p, be_r). \tag{44}$$

Note in particular that this implies that the poor son's consumption is strictly higher when the son works: $e_p > be_r$. As with transfers, the rich parent subsidizes education only if his utility is higher than when he makes no subsidy and lets part of his son's endowment be appropriated:

$$U(y_r - se_p - e_r, e_r) > U(y_r - e_r^*, (1-b)e_r^*). \tag{45}$$

As before, it can be shown that when the poor parent's endowment is sufficiently low, the subsidy which satisfies $U(y_p - (1-s)e_p, e_p) = U(y_p, be_r)$ is so high that the rich parent prefers a zero subsidy. The following analysis therefore assumes that the endowment differences are moderate, so that $U(y_r - se_p - e_r, e_r) > U(y_r - e_r^*, 1-b)e_r^*)$.

The question we now ask is whether the rich prefer compulsory schooling or education subsidies. Letting $S = se_p$, this question, in turn, amounts to asking whether $S > C$.

To examine this issue, suppose that $C = S$, where the associated s satisfies equation (44). Since under this assumption the transfer by the rich parent is the same with a subsidy as with compulsory schooling, the right-hand sides in (36) and (44) are equal. The left-hand side in (36), however, must be higher than in (44). The reason is that a subsidy entails the substitution effect in addition to the income effect, which is the only one present with compulsory schooling. It is well known then that, with a given transfer, a person's welfare is higher without the substitution effect. To maintain the equality in (36), C should therefore be smaller than S.

We thus have proved

Proposition 6 *A rich parent prefers to finance fully a mandatory level of schooling over subsidizing education spending by the poor.*

Note that the rich parent may prefer compulsory schooling even though he pays for all of it, in contrast to paying only some of the costs of educating the poor with subsidies. Again, compulsory schooling dominates a subsidy to education because it ensures that the poor son gets educated, instead of the poor parent using some of the subsidy to increase his consumption.

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